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THE WORK OF THE YUMA RECLAMATION PROJECT EXPERIMENT FARM IN 1917

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A Field of Durum Wheat Grown on the Yuma Reclamation Project

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THE PROGRESS OF AGRICULTURAL DEVELOPMENT.

The year 1917 was by far the most prosperous ever experienced on the Yuma project. There was marked evidence of a more stabilized production of each of the principal crops than in past seasons. Statistics assembled by the United States Reclamation Service show that the average gross returns per acre of the entire area cropped was $105.47, which was more than double that of last season. This large return was due mainly to the increased prices received, although the average yields per acre of nearly all crops show a slight increase over yields of previous years. This probably reflects the improvements which have been made in farm methods. The production of the principal crops, ranked in order of their total gross returns, were as follows: Cotton, alfalfa hay, grain sorghum, and alfalfa seed. If considered on a basis of total acreage, they rank in the same order except that alfalfa hay precedes cotton.

All branches of live-stock production except sheep growing showed a decrease in 1917. These are perhaps the only industries that do not indicate an endeavor to reach greater production as demanded by prevailing war conditions.

THE YUMA EXPERIMENT FARM.

The crops and plants under test at the Yuma Experiment Farm are chiefly those of commercial importance already being grown on the Yuma Reclamation Project and also others that may prove of

value in this area as well as on other projects along the lower Colorado River. The experiment farm was established in 1910, and since that time more than 2,500 species, varieties, or strains of seeds and plants have been tested. A report of the behavior of some of these plants is made in this paper, while in regard to others insufficient information has as yet been acquired to warrant public consideration.

An addition of 6 acres of rough land on the experiment farm (on plat series C and D, as shown in fig. 1) was leveled and made available

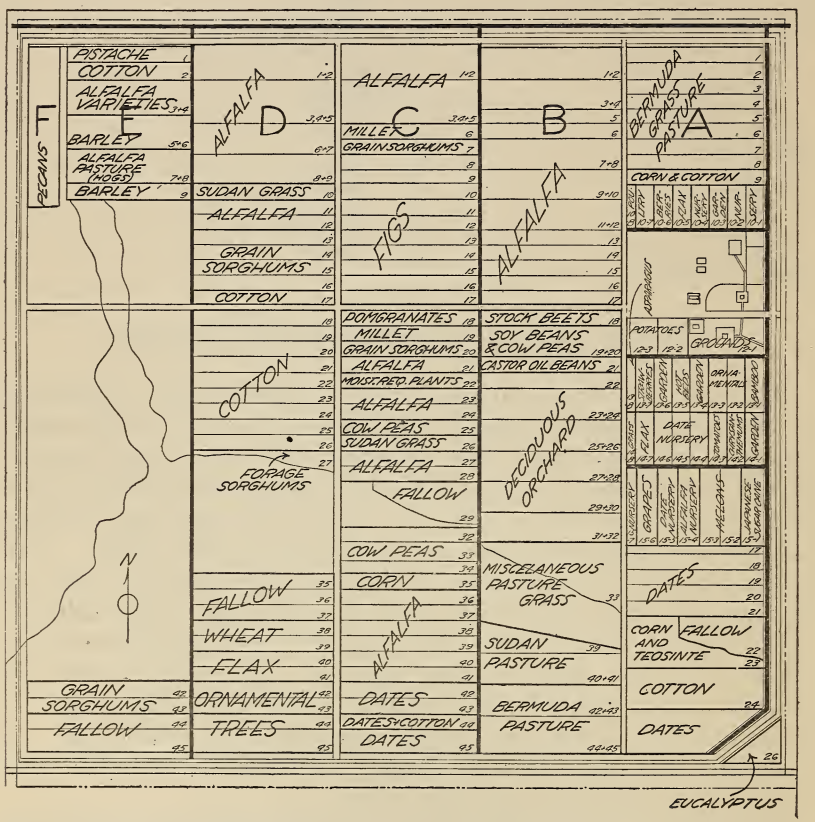


FIG. 1.—Diagram showing the arrangement of the fields and the location of the experiments at the Yuma Experiment Farm in 1917.

for experimental plantings. A part of this area was very carefully prepared by first leveling the heavy silt soil and then bringing sand to the depth of about 5 inches from a near-by ridge as a surface soil. This extra labor and expense were incurred in order to provide land that would be uniform for experimental planting. The main irrigation ditch on the north side of the experiment farm and the west lateral, a total of three-fourths of a mile, were fenced with woven wire, to provide a location for pasturing sheep on Bermuda grass ditch banks.

CONDITIONS ON THE PROJECT.

CLIMATIC CONDITIONS.

Weather conditions during 1917 were rather irregular, but not unusually so. Low temperatures at night continued late into the spring, which conditions greatly retarded the germination of early-planted cotton. In many places replanting was necessary. During the month of July unusually high humidity obtained, with several light showers. Such a condition was not at all desirable for the development of the cotton crop at that season and was also damaging to alfalfa seed then maturing and being harvested. The first general killing frost in the autumn occurred on November 29, although light frosts were noticeable in localized areas before that date. The total period of frost-free weather was 260 days, which was about one week longer than the normal. This condition was particularly favorable to late-maturing crops of cotton, broom corn, and grain sorghum.

The lowest minimum temperature of the year was only 29° F. and occurred during January. The total precipitation for the year was 3.71 inches, which is about normal as compared with the average at the experiment farm for the last eight years. However, the precipitation recorded at the United States Weather Bureau laboratory at Yuma, Ariz., was 30 per cent less than that recorded at the experiment farm, which indicates the localized character of many of the small showers that made up the limited total precipitation of the year. There was a period of more than three months at the close of the year without precipitation, which allowed an excellent season for the cotton harvest without damage to the unpicked crop. Evaporation for the year was a little below normal, which was due to the relatively high humidity existing through the late summer.

The Colorado River was at a stage of very high flood during late June and early July, but was held within the levees at all points by the efficient work of the Reclamation Service. The volume of discharge was greater than ordinarily occurs at flood season of this stream, but continued over a longer period of time, which tended to deepen the course of the river much below normal before the crest of the flood occurred. A few farms lying near the river levees were badly damaged by seepage water, which is forced up through the subsoil by the pressure against the levees during a long-continued flood period.

The climatological observations made at this station during the 8-year period from 1910 to 1917, inclusive, are summarized in Table I.

TABLE I.—*Summary of meteorological observations at the Yuma Experiment Farm for the 8-year period from 1910 to 1917, inclusive.*

PRECIPITATION (INCHES).

Year, etc.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
Average for 8 years, 1910 to 1917, inclusive	0.717	0.353	0.353	0.180	0.094	0.648	0.462	0.362	0.136	0.243	0.356	0.271	3.93
For 1917	1.29	.15	0	.24	.01	0	1.68	.19	.15	0	0	0	3.71

EVAPORATION (INCHES).

Average for 8 years, 1910 to 1917, inclusive	2.956	3.910	6.385	6.891	9.603	10.244	9.882	9.369	7.407	5.743	3.804	2.803	78.996
For 1917	2.036	3.572	6.118	6.965	8.855	9.435	8.894	8.500	6.090	5.290	3.184	2.587	71.526

AVERAGE DAILY WIND VELOCITY (MILES PER HOUR).

Average for 8 years, 1910 to 1917, inclusive	2.8	3.1	3.2	3.2	3.1	2.5	2.3	2.0	1.8	2.1	2.3	2.6	.....
For 1917	2.3	2.5	3.2	2.9	3.1	1.5	1.4	.9	1.0	1.0	1.2	1.2	.....

TEMPERATURE (° F.).[1]

Absolute maximum: 8 years, 1910 to 1917, inclusive	84	88	99	106.5	120	117	116	113.5	116	109	94	82	120
For 1917	72	80	93	95	98	117	112	109	107	109	93	82	117
Absolute minimum: 8 years, 1910 to 1917, inclusive	16	27	30	32	33	47	55	54	44	36	28	16	16
For 1917	29	32	30	34	43	53	67	56	44	36.5	32	30	29
Mean: 8 years, 1910 to 1917, inclusive	52.56	55.87	61.42	67.42	73.60	81.16	87.66	87.21	81.40	70.13	60.30	51.03	69.12
For 1917	49.71	55.12	56.77	64.10	67.69	82.28	89.35	83.05	78.76	73.03	60.88	54.95	67.97

KILLING FROSTS.

Year.	Last in spring.		First in autumn.		Frost-free period.
	Date.	Minimum temperature.	Date.	Minimum temperature.	
		° F.		° F.	*Days.*
1910	.....	.....	Nov. 27	32	.....
1911	Feb. 24	32	Nov. 24	32	262
1912	Mar. 31	32	Dec. 4	31	247
1913	Mar. 28	32	Dec. 2	31	248
1914	Mar. 4	31	Dec. 4	32	275
1915	Mar. 3	31	Nov. 13	31	254
1916	Mar. 25	31.5	Nov. 17	31	237
1917	Mar. 13	30	Nov. 29	32	260

[1] The records of maximum and minimum temperatures date from April 21, 1910.

IRRIGATION DEVELOPMENT.

The general stimulation for increased production during 1917 was made evident on the Yuma project by the clearing, leveling, and farming of 7,295 acres of new land. This represents an addition to the cultivated area of more than the combined increases of the two

previous years. The total area irrigated was 36,956 acres, which is 51 per cent of the total land available for irrigation on the Yuma project, as compared with the 40.7 per cent irrigated in 1916. The only change in the plan of operation of the Yuma project by the Reclamation Service was the elimination of the area known as the Gila Valley, which in 1916 included about 1,000 acres under irrigation.

The development of irrigation on the Yuma project for the 6-year period from 1912 to 1917, inclusive, is summarized in Table II.[1]

TABLE II.—*Summary of irrigation development on the Yuma Reclamation Project during the 6-year period from 1912 to 1917, inclusive.*

Items of comparison.	1912	1913	1914	1915	1916	1917
Water diverted.....acre-feet..	96,409	127,307	205,207	246,786	249,700	337,597
Water delivered to farms.do....	63,273	85,411	93,167	92,897	94,393	136,541
Water delivered per acre irrigated.....acre-feet..	7	4.36	3.69	3.34	3.20	3.7
Length of canals operated.miles..	173	227.5	249.5	307.3	316	335
Land irrigable.....acres..	38,500	50,000	60,000	72,440	72,440	72,440
Land irrigated.....do....	13,767	19,607	25,207	27,857	29,483	36,956
Number of farms irrigated.....	470	616	698	737	790	900
Average population per farm....	3.2	2.7	3.6	2.8	2.6	3.0
Total population on farms.....	1,490	1,793	1,815	2,036	2,002	2,700
Owners on farms.....	.....	496	468	659	453	505
Tenants on farms.....	.....	120	129	249	297	339
Area cropped.....acres..	11,060	16,726	22,568	25,101	28,283	35,578
Financial showing:						
Total value of crops.....	$497,103.00	$610,228.00	$709,409.00	$873,721.00	$1,435,403.00	$3,752,669.00
Value of crops per acre cropped.....	44.90	36.48	31.43	34.81	50.00	105.47
Value of crops per farm.....	1,057.50	993.00	1,016.00	1,185.51	1,816.90	4,169.52
Value of livestock per farm..	952.00	1,250.00	1,201.00	1,071.67	1,018.80	905.46

The general prosperity of the project during the year is shown in improvements and better equipment on farms and the greatly stimulated commercial development of the towns on the project. Many building improvements have been made in all the towns, and several new school buildings have been constructed on the project. A great many changes of land ownership have taken place, while land values and rentals are much advanced. The total value of crops produced on the entire project during the year amounts to a little more than three and three-quarter million dollars.

CROP CONDITIONS.

Alfalfa hay produced a larger average yield per acre in 1917 than during either of the three years immediately preceding, while the acreage was increased 18.6 per cent. Some of this hay was shipped to Los Angeles, Cal., and to various Arizona markets and sold for very good prices. However, with the increased leveling of new land much of the hay produced was needed for local feeding. Alfalfa seed was

[1] The figures in Tables II to V and XIX have been taken from data collected by the local office of the United States Reclamation Service in annual census reports. The writer desires to express his appreciation for the use of these records, which embody information of general interest.

produced on 4,643 acres, which is only about one-half of the area that produced seed during the previous year. The average yield per acre, however, was the highest that has been obtained for several years. The reduction of the acreage of alfalfa seed was no doubt due to the high prices received for alfalfa hay, which prompted the farmers to harvest all crops for hay and not attempt to produce a seed crop. There was a particular demand for good hairy-leaved Peruvian alfalfa seed, which sold late in the summer at 40 to 45 cents per pound. Many farmers would have secured higher yields of alfalfa seed had it not been for various small showers that occurred during the period of harvest.

The one industry that expanded beyond all others was cotton production. A total of 12,706 acres of cotton was grown in 1917, as compared to 4,670 acres in 1916. Of this acreage, about one-third was of the Yuma variety of Egyptian cotton, while the remainder was of American Upland type, mostly short-staple varieties. The average return per acre amounted to $171.51, as compared with $100.15 for the previous year. In order to handle this cotton crop, one 12-stand roller gin and three additional 4-stand saw gins were constructed at various towns on the project. During the ginning season one of the saw gins was destroyed by fire. One cottonseed-oil mill was operated, and the remainder of the seed produced was shipped to other points for milling.

Some very good yields of both Egyptian and Upland cottons were produced, but the average yields per acre of both types were lower than the yields of most years. While the long season without an early killing frost was favorable for maturing the top crops of cotton, the weather of late June and July was very unfavorable for the desired plant growth and setting of bolls. The normal irrigations of June were followed by much humid and slightly rainy weather, accompanied by high temperatures. This condition stimulated a very rapid and rank plant growth, which resulted in the failure of the cotton to retain the squares and bolls. The damage to the Egyptian cotton crop seemed to be more severe than to the Upland varieties, although both were badly overgrown on the most productive soils.

As there was only one roller gin on the project, it was necessary for a great many of the growers of Egyptian cotton to haul their seed cotton long distances, which made ginning unsatisfactory. The growers who produced Durango cotton were not able to sell the product for as good a price as it would have commanded had not the fiber been damaged by improper ginning. There is urgent need on the project for the proper handling of certain saw gins that can be adjusted for ginning this type of cotton. Farmers growing Durango cotton should insist on such adjustment when this cotton is brought to the gin.

A cooperative farmers' association was formed among the growers of Egyptian cotton to assist in supplying extra labor at picking time and to facilitate the classing and marketing of this crop. The total production of cotton in 1917 was ample to attract buyers of several cotton firms to the Yuma project. The great increase in the cotton acreage on the Yuma project, while drawing heavily from other industries, will ultimately have the desirable effect of ridding many farms of worn-out alfalfa meadows and pastures and reseeding them with the hairy-leaved Peruvian alfalfa when that crop is again planted.

The production of grain sorghums was more extensive than during any previous year, resulting in an average yield of 40 bushels an acre. This grain brought a very good price. The two principal varieties grown were Dwarf milo and feterita.

Probably because of the increased acreage of land being prepared for cotton, the fall plantings of wheat and barley were reduced from 1,651 acres in 1916 to 900 acres in 1917. The average yield per acre was 27.84 bushels, as compared with 21.39 bushels during 1916.

The wheat grown included the Sonora and Early Bart varieties and a small acreage of durum wheat. On the title-page of this publication is shown a view of a field of durum wheat grown on the Yuma project.

TABLE III.—*Yields and farm values of crops grown on the Yuma Reclamation Project in 1917.*

Crop.	Area (acres).	Unit of yield.	Yields.			Farm values.		
			Total.	Per acre.		Per unit of yield.	Total.	Per acre, average.
				Average.	Maximum.			
Alfalfa hay	12,901	Ton	43,177	3.3	10	$15.00	$642,870	$49.83
Other hay	306	do	882	2.5	4	10.00	8,811	28.79
Alfalfa seed	4,643	Pound	1,588,500	342.1	12	.1655	262,928	56.62
Barley	716	Bushel	21,578	3.0	60	1.13	24,366	34.03
Wheat	184	do	3,479	19.0	40	1.81	6,314	34.31
Grain sorghums	6,883	do	280,539	40.0	100	1.00	281,120	40.84
Corn	346	do	10,230	29.0	35	1.05	10,757	31.08
Cane and corn fodder	309	Ton	1,770	5.7	10	9.00	15,930	51.55
Cotton, Egyptian	4,270	Pound	1,064,804	249.0	520	.70	743,787	174.19
Cotton, Durango	369	do	173,150	469.0	700	.31	53,676	145.46
Cotton, short staple	8,067	do	4,015,500	498.0	1,000	.28	1,124,340	139.37
Total cotton	12,706	do	5,253,454				1,921,803	151.25
Cottonseed	12,706	Ton	6,190	.49		58.00	359,020	28.25
Broom corn	303	do	98	.33	.75	264.79	25,950	85.64
Beans	367	Bushel	4,454	12.0	15	4.55	20,329	55.39
Truck	746						80,617	108.06
Fruit	155						7,544	48.67
Pasture	1,857						24,278	13.07
Additional revenue[1]							60,032	
Less duplications	32,256						1,921,803	
Total	35,578						3,752,669	
Average								105.47

[1] From pasturing alfalfa, thrashed straw, and stalk lands in winter.

Two other field crops that have been grown profitably by certain farmers are tepary beans and broom corn. A little more than 300 acres of each of these crops was produced during 1917. Tepary beans produced an average yield of 12 bushels per acre, and broom corn an average of 0.33 ton of brush per acre. The yields and farm values of the crops grown on the project in 1917, as reported by the United States Reclamation Service, are shown in Table III.

The production and values of the five principal money crops grown on the Yuma project in 1917 are compared in Table IV with the statistics of these crops for the years 1911 to 1916, inclusive.

TABLE IV.—*Acreage, production, and farm values of the principal crops grown on the Yuma Reclamation Project in the 7-year period from 1911 to 1917, inclusive.*

Item and year.	All crops.	Alfalfa hay.	Alfalfa seed.	Grain sorghums.	Wheat and barley.	Cotton.[a]
Acreage:						
1911	8,570	3,750	[b] 2,600	420	1,290	30
1912	4,060	7,269	2,824	986	1,567	25
1913	16,726	10,321	3,388	2,928	1,586	62
1914	22,568	10,426	5,485	3,066	2,223	2,268
1915	25,101	9,441	6,449	6,408	3,838	709
1916	28,283	10,880	8,100	4,897	1,651	4,670
1917	35,578	12,901	4,643	6,883	900	12,706
Production:		*Tons.*	*Pounds.*	*Bushels.*	*Bushels.*	*Pounds.*
1911		16,327	576,730	13,106	39,083	15,000
1912		27,078	814,186	31,372	55,375	5,800
1913		38,100	1,139,100	112,597	45,075	19,610
1914		32,525	1,246,318	100,153	61,674	845,044
1915		24,277	1,669,020	231,185	88,182	359,850
1916		28,029	2,635,800	195,799	35,306	2,289,430
1917		43,177	1,588,500	280,539	25,057	5,253,454
Average yield per acre:						
1911		4.36	222	31.5	30.6	500
1912		3.73	288	31.8	35.3	232
1913		3.69	336	38.5	28.4	316
1914		3.12	227	32.6	27.8	373
1915		2.57	258.6	36.1	22.9	507.6
1916		2.58	325.2	39.97	21.39	490
1917		3.3	342	40.00	27.84	413.5
Farm values per unit of yield:						
1911		$15.00	$0.16	$0.854	$0.66	$0.20
1912		10.00	.10	.75	.75	.20
1913		7.53	.111	.513	.668	.21
1914		6.05	.13	.70	.676	.08
1915		7.15	.1475	.63	.739	.109
1916		9.52	.1247	.64	.835	.174
1917		15.00	.1655	1.00	1.22	.366
Farm values per acre:						
1911	$51.80	65.44	32.52	23.62	20.20	100.00
1912	44.94	37.30	28.80	23.85	26.47	46.40
1913	36.48	27.83	37.33	19.72	18.95	66.50
1914	31.43	18.86	29.15	23.13	21.13	30.80
1915	34.81	18.36	38.66	22.61	16.97	61.59
1916	50.75	24.53	40.58	25.50	17.84	100.15
1917	105.47	49.83	56.62	40.84	34.09	179.51
Total farm values:						
1911	443,984.00	244,905.00	92,276.00	11,180.00	25,775.00	3,000.00
1912	497,012.85	270,780.00	81,418.60	23,529.00	41,517.00	1,160.00
1913	610,228.00	287,195.00	126,450.00	57,740.00	30,131.00	4,123.00
1914	709,409.00	196,716.00	159,806.00	70,915.00	41,373.00	78,399.00
1915	873,721.00	173,297.00	249,331.00	144,892.00	65,135.00	39,271.00
1916	1,435,403.00	266,898.00	328,725.00	124,915.00	29,465.00	467,697.00
1917	3,752,669.00	642,870.00	262,928.00	281,120.00	30,680.00	2,280,823.00

[a] Farm value per acre and total farm value of cotton include both fiber and seed.
[b] This area is included in the alfalfa-hay acreage for 1911.

LIVE-STOCK INDUSTRIES.

An inventory of the live stock on hand on the Yuma project on December 31 of each year from 1911 to 1917, inclusive, is given in Table V. These figures do not indicate the extent of live-stock production for each year, but afford a comparison of the relative development of the different divisions of the industry from year to year. Perhaps the most important fact revealed in this census for 1917 is the general reduction in number of all meat-producing live stock except sheep. This is due undoubtedly to the prevailing high prices obtainable for hay and grain and to the reduced acreage of pasture on the project.

The reductions of live-stock population since 1916 were as follows: Swine, 40.6 per cent; beef cattle, 22.7 per cent; dairy cattle, 16.7 per cent. The number of sheep on hand increased 13.5 per cent, but still represents only a very small industry. This increase was probably occasioned by a growing interest in pasturing sheep on ditch banks infested with Bermuda grass.

TABLE V.—*Inventory of live stock on hand on the Yuma Reclamation Project at the close of each year, for the 7-year period from 1911 to 1917, inclusive.*

Live stock.	1911	1912	1913	1914	1915	1916	1917
Number:							
Horses	1,570	1,705	2,111	2,465	2,898	2,950	3,223
Mules	362	440	560	544	612	756	933
Beef cattle[1]	967	1,197	3,900	2,851	3,446	2,251	1,740
Dairy cattle				2,043	2,249	2,234	1,875
Sheep				1,384	1,251	702	797
Hogs	1,767	2,634	2,886	4,982	12,500	13,688	8,136
Ostriches	40	121	184	193	121	91	70
Fowls	22,857	25,646	27,882	35,935	50,723	43,361	27,537
Bee colonies	2,433	2,542	2,712	4,062	2,480	4,569	2,104
Average value per head or unit:							
Horses	$106.00	$107.52	$105.00	$99.48	$90.20	$100.75	$103.43
Mules	128.00	127.33	150.00	138.37	126.86	117.02	132.27
Beef cattle[1]	51.40	49.52	58.00	37.68	44.66	43.04	55.81
Dairy cattle				81.42	73.02	41.40	66.69
Sheep				4.65	4.69	7.85	10.97
Hogs	7.15	9.07	8.65	7.60	6.49	7.90	10.42
Ostriches	315.00	186.95	145.00	5.57	5.83	17.69	50.00
Fowls	.64	.65	.62	.79	.65	.78	.94
Bee colonies	3.15	3.21	4.00	4.80	4.84	3.40	6.83
Total value:							
Horses	166,389	183,364	221,525	245,227	261,410	295,245	333,351
Mules	46,340	56,030	84,329	75,272	77,640	88,470	123,417
Beef cattle[1]	49,705	59,270	224,251	107,434	153,906	96,873	96,981
Dairy cattle				166,335	164,235	159,505	125,055
Sheep				6,432	5,868	5,513	8,740
Hogs	12,627	23,903	24,965	37,848	81,122	108,183	85,805
Ostriches	12,600	22,625	26,610	1,075	705	1,610	3,500
Fowls	14,559	16,578	17,180	28,342	32,936	33,923	25,702
Bee colonies	7,674	8,159	10,832	19,499	12,002	15,565	13,370
Total	309,934	369,929	609,692	687,484	789,824	804,887	815,921

[1] Beef and dairy cattle for 1911, 1912, and 1913 were not segregated.

The total number of horses and mules on the project increased by 12.1 per cent, which represents more than a normal increase of young stock. The development of new land demanded an importation of work stock for leveling during the cooler months of the year. This

demand was not entirely equalized, as excess mules and horses were not abundant throughout the Southwest. At the close of 1917 there was an average of 4.64 head of work stock for each farm, amounting to one head to 8.56 acres for the entire area cropped.

There was also a reduction in the number of fowls held on farms, which was due to high prices of feed. Apiculture seems to have been reduced greatly by the close of 1917, as the number of bee colonies decreased 54 per cent. This reduction occurred principally among the smallest apiaries, although several of the larger apiaries were disbanded entirely.

DISEASES AND PESTS.

Animal diseases.—Very little loss from disease was experienced in any line of live-stock production during the year. The most serious diseases that have occurred in past years are hog cholera and necrobacillosis of hogs, blackleg of cattle, contagious abortion in dairy herds, and white diarrhea of turkeys. Some losses occur each year from alfalfa bloat in cattle and also from overheating work horses during the summer months.

Insect pests.—Field crops suffered no more than usual injury from destructive insects that occur in this region, except from plant bugs. The damage caused by these pests was more general than during any past season, although the most severe losses in cotton crops occurred in certain localized areas. In some fields the yields of cotton were reduced as much as 30 per cent by the ravages of a plant bug. This same insect also feeds on immature grains of the different sorghums. Since the adult insect passes the winter in grass, brush, or rubbish, the injury to cotton is often most severe in fields where grain-sorghum stalks have been allowed to stand during the winter or where the field adjoins areas of uncleared land. Perhaps the most effective means of controlling this pest is by carefully burning off during the winter all grass-covered ditch banks, brush, weeds, or trash where winter cover is afforded for this insect. The injurious effect of this pest to cotton was considered in the report of this station for 1916.

The attacks against crops by the spring-grain aphis, alfalfa butterfly, and alfalfa-seed chalcis fly were generally light over the whole project. Severe damage was wrought on many early-fall garden and seedling-onion plantings by grasshoppers, while plant lice and red spiders were injurious to ornamentals and truck crops from time to time throughout the year.

Plant diseases.—Diseases affecting the leaves and stems of plants do not often become economically important on the Yuma project, as the dry atmosphere which generally prevails tends to prevent their development. Occasionally rusts and smuts of grain crops cause serious loss, but only the latter was abundant during 1917. Sore-

shin of seedling cotton was prevalent during the period of cool nights in the spring, but soon disappeared with the warmer weather. Cotton root-rot was, however, more noticeable than in any past season. This disease may have been more obvious on account of the greater area planted to cotton. It should be recognized by farmers as a fungus existing in the soil which attacks all field-crop plants that grow with a taproot. Only the fibrous-rooted plants, such as sorghum, corn, the small grains, and grasses, are known to be immune to the effects of this fungus. No thoroughly effective means of control has been found except by a process of "starving out" through keeping the field free from host plants of this fungus and growing some grasslike crops for several years. When a farmer finds parts of a field so badly infested with this disease as to reduce severely a cotton stand he should not plant these borders to either alfalfa or cotton for several years, but instead should grow wheat or barley as a winter crop and grain or hay sorghums or Sudan grass for a summer crop.

The two most important diseases now found affecting fruit crops on the project are mildew of grapes and the fermenting fungus of dates. Grape mildew may be controlled by dusting the vines with powdered sulphur. Two, and sometimes three, treatments are necessary. The first should be applied when early growth begins, the second at blooming time, and the third at about the time the grapes begin to ripen. The development of the date fungus is stimulated by rain or high humidities, and as yet no means of control has been developed. The degree of the susceptibility of the fruit to fungous injury governs to some extent the adaptability of varieties to particular areas of this region having slightly varied climatic conditions.

The matters of quarantine and inspection to prevent the introduction of injurious insects and plant diseases along with plants and seeds imported from outside sources have been much improved on the Yuma project for the past year by the Commission of Agriculture and Horticulture of Arizona. An officer with special training in these lines has been located at Yuma and has devoted his entire attention to such work. Since Yuma is the point of entry of such shipments to the entire project, this officer is cooperating with a corresponding officer of California and is inspecting all shipments of plants and seeds to the Yuma project and Yuma County.

Bird and animal pests.—Crop conditions as affected by bird and animal pests in 1917 did not vary much from such injury during previous years. There was, however, a noticeable increase of birds of apparently undetermined sorts about all farms. This is likely a natural increase accompanying the development of the country, as more orchard and shade trees develop and more food plants and insects are present.

Weed pests.—All weeds which were discussed in the last two reports of this station are still troublesome pests to most farmers on the project, but conditions are perhaps no worse than in the past. Two other weed pests, which it seems are becoming troublesome in certain areas and which should be thoroughly controlled, are the sand-bur grass (*Cenchrus* sp.) and ground-bur nut (*Tribulus terrestris*). The other most serious weeds of the area are sour clover (*Medicago indica*), Johnson grass (*Holcus halepensis*), Bermuda grass (*Capriola dactylon*), dodder (*Cuscuta* sp.), water grass (*Leptochloa* sp.), and cocklebur (*Xanthium* sp.). The many other weeds which occur so conspicuously, as well as a few of those mentioned, can readily be controlled in field crops by good cultivation.

CROP EXPERIMENTS.

The crop experiments reported in this paper are mainly those relating to the principal money crops of the region which have been under test at the experiment farm for several seasons. While considered mainly with regard to conditions on the Yuma project, the results are often of importance to adjacent valleys, especially Imperial Valley and Palo Verde Valley, from which calls for information regarding these particular crops are received very frequently. Some less important crops are also briefly treated.

The principal experiments conducted during 1917 were (1) cultural and varietal tests of cotton; (2) the breeding of Durango, Tuxtla, and Kekchi cottons; (3) the testing of alfalfa varieties; (4) the pasturing of alfalfa by hogs; (5) the pasturing of Bermuda grass by steers; (6) the testing of miscellaneous forage crops; (7) the testing of flax varieties for seed production as a winter crop; (8) cultural and varietal tests of grain sorghums; (9) the testing of varieties of deciduous fruits; (10) the fruiting of seedling dates, figs, and pomegranates; (11) the testing of varieties of grapes and berries; (12) the culture of truck crops; and (13) the testing of various perennial ornamentals. The series of tests with cotton have probably been of more interest to farmers visiting the station than those of all other crops, as that industry was expanding most rapidly of all.

COTTON.

VARIETY TEST.

The varieties of cotton included in the general variety test conducted during 1917 numbered 27, of which 23 were grown in a similar test during 1916, and many have been included in like tests of other years. The yields of these varieties and their rank with the other varieties of that type of cotton are shown in Table VI.

TABLE VI.—*Yields of varieties of cotton grown on the Yuma Experiment Farm in 1917, showing a comparison with the yields in 1916.*

Varieties.	Rank in 1917.	Yield of seed cotton per acre (pounds).		Rank in 1916.	Varieties.	Rank in 1917.	Yield of seed cotton per acre (pounds).		Rank in 1916.
		1917	1916				1917	1916	
Long-staple (fiber $1\frac{7}{16}$ to $1\frac{3}{8}$ inches):					Short-staple (fiber 1 inch to $1\frac{1}{8}$ inches):				
Pima	1	2,184	.....	.....	Express	1	1,907	1,263	6
Yuma	2	2,169	a 658	3	Acala	2	1,808	2,620	1
Meade	3	1,422	a 981	2	Tuxtla (acclimated seed)	3	1,726	.....	.....
Snowflake	4	1,422	1,007	1	Tuxtla (eastern seed)	8	1,028	1,756	3
Sea Island	5	119	105	4	Triumph (Mebane)	5	1,361	1,513	5
Long-staple Upland (fiber $1\frac{3}{16}$ to $1\frac{5}{16}$ inches):					Keenan	4	1,375	477	7
Durango No. 13 (selected strain)	1	2,022	.....	.....	No. 624	7	1,122	1,755	4
Durango No. 18 (selected strain)	2	1,913	.....	.....	Holdon	6	1,214	1,784	2
Durango (bulk seed)	6	1,654	1,761	1	Short-staple (fiber 1 inch or less):				
Foster	3	1,787	1,109	4	Dixie	1	2,620	2,296	1
Columbia	4	1,767	1,290	3	King	2	1,997	1,809	4
Kekchi	7	1,251	917	5	Ideal	3	1,851	1,701	5
Lewis	5	1,668	1,390	2	Trice	4	1,794	1,593	6
Mixson	8	1,227	.....	.....	Cleveland	5	1,769	2,079	2
					Half and half	6	1,707	1,972	3
					Sproull	7	1,634	.....	.....

a These varieties were planted too late for yields to be comparable with other varieties in the test during 1916.

TABLE VII.—*Comparative costs and returns* [1] *from varieties of cotton based on yields produced on the Yuma Experiment Farm in 1917.*

Items of comparison.	Market and cost conditions.									
	Pima variety.		Yuma variety.		Durango variety.		Acala variety.		Tuxtla variety.	
	1917	Previous years.	1917	Previous years.	1917	Previous years.	1917	Previous years.	1917	Previous years.
Average yield:										
Seed cotton, per acre, pounds	1,669	.....	1,686	.....	1,882	.....	2,033	.....	1,918	.....
Seed cotton, per 500 pounds of fiber, pounds	1,800	.....	1,800	.....	1,565	.....	1,500	.....	1,500	.....
Fiber, per acre, do	464	.....	469	.....	601	.....	678	.....	640	.....
Calculated production costs:										
Land rent, per acre	$25.00	$20.00	$25.00	$20.00	$25.00	$20.00	$25.00	$20.00	$25.00	$20.00
Water, per acre	2.25	2.25	2.25	2.25	2.25	2.25	2.25	2.25	2.25	2.25
Preparing and growing crops, per acre	30.00	20.00	30.00	20.00	30.00	20.00	30.00	20.00	30.00	20.00
Picking seed cotton, per pound	.04	.02½	.04	.02½	.02½	.01½	.02	.01½	.02	.01¼
Total picking, per acre	66.76	41.73	67.44	42.19	47.05	28.23	40.66	25.41	38.36	23.98
Ginning, per bale	12.00	10.00	12.00	10.00	8.00	6.00	7.00	5.00	7.00	5.00
Ginning, per acre	11.12	9.27	11.27	9.38	9.62	7.21	9.49	6.78	8.96	6.40
Labor importation, per acre	2.00	.....	2.00	.....	2.00	.....	2.00	.....	2.00	.....
Handling and marketing—										
Per bale	1.50	.75	1.50	.75	1.00	.50	1.00	.50	1.00	.50
Per acre	1.39	.70	1.41	.71	1.20	.60	1.35	.68	1.28	.64
Total, per acre	138.52	93.95	139.57	94.53	117.12	78.29	110.75	75.12	107.85	73.27
Financial returns:										
Current price, per pound—										
Fiber	.76	.26	.70	.22	.40	.16	.30	.11	.30	.11
Seed	.03	.01½	.03	.01½	.03	.01½	.03	.01½	.03	.01½
Total value—										
Fiber	352.64	120.64	328.30	103.18	240.40	96.16	203.40	74.58	192.00	70.40
Seed	36.15	18.08	36.51	18.26	38.43	19.22	40.65	20.33	38.34	19.17
Total gross returns, per acre—										
1917 conditions	388.79	.....	364.81	.....	278.83	.....	244.05	.....	230.34	.....
Previous years	.....	138.72	.....	121.44	.....	115.38	.....	94.91	.....	89.57
Total net returns, per acre—										
1917 conditions	250.27	.....	225.45	.....	161.71	.....	133.30	.....	122.49	.....
Previous years	.....	44.77	.....	26.91	.....	37.09	.....	19.79	.....	16.30

[1] The various items of cost and returns used in the calculations in this table are considered as averages prevailing on the Yuma project for the periods included.

The varieties included in Table VI were grown in plats of small area, but they furnish a useful comparison of the behavior of these different cottons. Those varieties of greatest worth, as determined by trials covering several years, were planted on much larger plats. The yields from these varieties and their values are stated in Table VII.

On the Yuma project there are now being commercially grown three distinctly different types of cotton, namely, Egyptian, Durango, and various short-staple varieties. This condition is unfortunate from the standpoint of developing a highly specialized long-staple cotton industry. It seems, however, that there is quite a variation in the way different types of soil have responded to the production of Egyptian and Upland cottons.

The various superior qualities of the Pima variety of Egyptian cotton over the Yuma variety are such as to induce every grower to produce this new variety. In order to show the relative performance of the two varieties, several plats of alternate 4-row blocks were planted on average soil on the experiment farm in 1917 and given identical treatment. This planting was made on March 13. Four different thinning practices were tested in each of these blocks, the first thinning being made on May 19. In plats that were thinned twice the second thinning was made on May 28. The results of these comparisons are shown in Table VIII.

TABLE VIII.—*Yield in the thinning tests of the Pima and Yuma varieties of Egyptian cotton on the Yuma Experiment Farm in 1917.*

[No yields of outside rows have been included in this table, as these are always greater than yields from interior rows of a border.]

Thinning distance between plants.	Number of—		Average yield of seed cotton per acre (pounds).		
	Times thinned.	Plats of each variety.	Pima.	Yuma.	Average of each thinning.
17 to 19 inches	1	3	1,661	1,654	1,658
13 to 15 inches	1	3	1,623	1,681	1,652
13 to 15 inches	2	3	1,562	1,512	1,537
9 to 11 inches	2	3	1,508	1,732	1,620
Average yield of all plats			1,586	1,645	

From the average yields as recorded in Table VIII it may be seen that there was not much difference in productiveness between the two varieties. It is evident that the Pima variety requires slightly more room between plants than the Yuma. This seems to be due to the fact that Pima plants exert less tendency toward the growth of the undesirable vegetative branches. This branch development [1] seems to be effectively retarded with less crowding within the row

[1] Cook, O. F. A new system of cotton culture and its application. U. S. Dept. Agr., Farmers' Bul. 601, 12 p. 1914.

than is required with the Yuma variety. Also Pima plants produce the bottom fruiting branches much nearer the ground than those on Yuma plants, and a more abundant entrance of light is necessary in order to obtain a round development of these lower bolls. The Pima variety proved to be a much more satisfactory cotton to grow, even aside from its superior lint values, because of its dwarf growth and its earliness. The relative earliness of Pima cotton is distinctly shown by a comparison of the first pickings of the two varieties. While the average total yields of the season show a small difference in favor of the Yuma, the average of the first pickings of the Pima plats was one-third greater than that of the Yuma plats. Practically all the Pima cotton on these plats was mature before the first killing frost occurred, which was on November 29. This was not true of the Yuma variety.

The plant behavior under local conditions of the best adapted varieties of Upland cotton is very similar, and all tests at this station point to the fact that only long-staple varieties of this class should be grown if the greatest profits are to be secured. This fact is borne out by the figures presented in Table VI. If prices such as were received for the 1917 crop should be maintained, there is a very good profit to be derived from short-staple cottons, but this condition can not be expected in the future of such an industry. There are, on the other hand, very good reasons to believe that Upland cottons of 1¼-inch staple, such as Durango, will always bring profitable prices. A need exists at present for better marketing arrangements for this type of cotton, which should be perfected through the combined efforts of the growers.

THINNING TEST.

A thinning experiment including the best adapted varieties of Upland cottons was conducted at this station the past year and is reported in Table IX.

TABLE IX.—*Yield in the thinning tests of varieties of Upland cotton on the Yuma Experiment Farm in 1917.*

Thinning distance between plants.	Number of—		Average yield of seed cotton per acre (pounds).			
	Times thinned.	Plats of each variety.	Durango.	Acala.	Tuxtla.	Average of each thinning.
9 to 11 inches	2	2	2,247	2,071	2,040	2,119
13 to 15 inches	2	2	2,032	2,093	1,980	2,035
13 to 15 inches	1	2	1,856	2,087	1,872	1,938
17 to 19 inches	1	2	1,965	1,878	1,778	1,874
Average yield of all plats			2,025	2,032	1,918	

From the results of the experiment recorded in Table IX may be observed the advantage in yields of delayed final thinning[1] and a relatively close spacing of plants in the row, as compared with only one thinning at an earlier date and plants at a greater distance in the row. These Upland varieties, both long and short staple, show a gain in yield when thinned by the first method. Attention is called to this fact, because it is not a general practice on the Yuma project. From a comparison of Tables VIII and IX it will be seen that the Egyptian cottons do not produce their maximum yields at a similar thinning distance. It seems likely that the yields from these tests are indicative of what may be expected from these varieties on average soil of the Yuma project and that maximum yields can be secured from Pima plants where they are thinned to about 14 to 16 inches and from Durango and short-staple varieties when the plants are about 12 to 14 inches apart in the row. Heavier soils will demand a slightly greater distance between plants, while on light sandy soils the plants may be left a little closer together. Two thinnings of varieties of Upland cotton and a close spacing within the row are profitable if labor can be employed at normal wages. A double thinning with the Pima variety does not seem equally profitable.

An interesting fact shown in Table IX is the very small difference between the average yields of seed cotton per acre of the Durango and Acala cottons, the latter being a short-staple variety which in a series of three years has produced the heaviest yields of all varieties tested at the experiment farm.

FURROW-AND-BED METHOD.

Some of the most productive soils on the project have given the heaviest yields of Upland cotton and relatively light yields of Egyptian cotton. The main difficulty experienced with the latter was that a very large, rank-growing plant was produced, which is never the most productive type. To the Egyptian grower with such soil there is the obvious cultural problem of how the plant growth can best be controlled without hindering its productiveness. With this end in view, work at the experiment farm has been conducted in testing various means for irrigating cotton by minimum applications of water. The most promising results obtained are those of a means of planting and irrigating along furrows, termed the furrow-and-bed method, as described in the report of this station for 1916. Further tests of this method were conducted in 1917. These consisted of testing beds of different breadths, with both the Pima and Durango varieties; a comparison of the two Egyptian varieties, Pima and Yuma; and different thinning distances with these three varieties.

[1] Cook, O. F. A new system of cotton culture and its application. U. S. Dept. Agr., Farmers' Bul. 601, 12 p. 1914.

Both the Yuma and Pima varieties produced slightly greater yields when grown by this method than when grown on similar soil by the ordinary method of flat planting. The highest yields of Pima cotton were obtained from plats having the pairs of rows spaced 6 feet apart between the centers of furrows. This arrangement, of course, makes a more dense growth on the ground than when row pairs are farther apart, and it seems that the increased yield does not justify the extra difficulty in handling the crop when compared to yields from plats with furrows 7 to 8 feet apart. The heaviest yields of Durango cotton planted by the furrow-and-bed method were obtained from plats having furrows 8 feet apart. Pima cotton under this method of culture produced greater yields when thinned to a distance of 12 to 16 inches between plants than at an average of 10 inches. By this test, as well as in the thinning experiment of Egyptian cotton varieties, it is evident that the undesirable vegetative branching of the Pima variety can be controlled without such dense crowding in the row as is necessary in order to restrict such branching in most other varieties.

Several cooperative tests of different distances of thinning were conducted with various farmers about the project, including both Yuma and Durango cotton. One such planting was also made with Pima cotton. During the growing season much time was spent by two of the employees at the station among cotton growers about the project in response to requests for information on irrigation and the cultural treatment of the crop. The chief difficulties experienced by the cotton growers were the occurrence of poor stands occasioned by too deep planting and the abundance of overgrown plants due to excessive irrigation. The latter condition was not always the fault of the farmer, as several fields on good soil were known to stand as long as 120 days after planting without irrigation, but these were later badly overgrown and consequently produced small yields. In these fields the first irrigation was not applied until it became necessary, but this happened to precede immediately an unusual period of light rains and high humidity, which has already been mentioned as occurring during late June and throughout July.

ALFALFA.

VARIETY TEST.

The experiments with alfalfa which were conducted during 1917 were not new, but mostly a continuation of tests already under way. The variety test reported for 1915 and 1916 was supplemented by a new block, which was planted in December, 1916, and included the varieties being commercially grown on the project along with the new variety, Indian, which in some tests has given indications of being promising for this region.

The total yields of field-cured hay per acre for the season from these varieties were as follows:

	Tons.
Hairy-leaved Peruvian	3.12
Smooth-leaved Peruvian	2.25
Indian	2.36
Chilean (common)	2.22

These yields are, of course, all relatively low, being the production of the first season following a winter planting. The Indian variety in this planting during its performance of the first year has not proved as valuable as hairy-leaved Peruvian. Other comparable plats of these two varieties planted in December, 1916, yielded field-cured hay per acre as follows: Hairy-leaved Peruvian, 3.38 tons, and Indian, 2.95 tons.

The original plantings of alfalfa varieties established in a nursery in 1915 were maintained throughout 1917 for further study. The experiments in plowing under green-manure crops in order to increase the following crops of alfalfa on light soils were advanced another season.

ALFALFA SEED.

Certain phases of the alfalfa-seed industry on the Yuma project were discussed in the reports of this station for the years 1915 and 1916. Tests in alfalfa-seed production at the experiment farm during 1917 included growing seed from duplicate plats of four different varieties which had been maintained during two previous years for a comparison of hay production. These plats were on light, sandy soil, not the type that generally produces heavy alfalfa-seed yields. The relative yields of these four varieties, together with their record of hay production for three years, are shown in Table X.

TABLE X.—*Seed yields of varieties of alfalfa grown on the Yuma Experiment Farm in 1917, with hay yields of previous years.*

Variety.	Dates.		Yields per acre.				
	Planted.	Seed crop harvested.	Seed crop, 1917.		Hay crop, total for season (tons).		
			Pounds.	Bushels.	1917	1916	1915
Peruvian	April 9, 1915	August 2, 1917	130	2.2	3.88	4.8	2.42
Chilean (common)	do	do	135	2.3	2.99	4.0	2.42
Arabian	do	do	202	3.4	2.05	2.5	1.96
Grimm	do	do	110	1.8	2.04	3.0	1.32

Seed crops were also produced from hairy-leaved Peruvian alfalfa growing on heavier soil, where row plantings 20 inches apart were compared with broadcasted plats. The row plantings produced 562 pounds of seed per acre and the broadcasted yielded 431 pounds per

acre. The same plats gave a total additional hay yield per acre for the year as follows: Rows, 3.78 tons; broadcasted, 5.35 tons. At average prices received for alfalfa seed and hay, the extra yield in seed is not of sufficient value to equalize the loss resulting from the smaller yield of hay obtained from the row plantings. These results agree with data obtained in a more extensive comparison at this station during 1914.

PASTURING ALFALFA WITH HOGS.

Pasturing tests of hogs on alfalfa as conducted during 1916 were repeated in 1917. A three-quarter acre plat of hairy-leaved Peruvian alfalfa which had been planted in November, 1914, was fenced and divided into two equal areas to allow alternate pasturing. Sixteen good grade Duroc-Jersey shotes were placed on pasture on March 1 and fed a supplemental grain ration of cracked milo of about 2 pounds a day for each 100 pounds of live weight. The average initial weight of the pigs was 57.9 pounds. Every animal was weighed individually each week, so that the desired grain ration for the following week might be computed. On May 12, after a grazing period of 72 days, the herd was turned into a field of common bearded barley on an adjacent plat. No supplementary grain was fed while the hogs were on the barley, but access to the alfalfa pasture was still allowed. At the end of one week the hogs were eating very little barley and the herd had lost 84 pounds in weight. Since it seemed evident that quite a loss in weight would occur before the hogs would eat a sufficient quantity of unthrashed bearded barley to make profitable gains, the herd was shut out of the barley plat, and on May 19 the feeding of cracked milo was resumed and continued until the hogs were marketed. These hogs were removed at an average weight of 145.5 pounds after a pasture period of 120 days.

A second lot, consisting of 12 shotes, was placed on the same pasture on July 31 and fed a supplementary grain ration of 2 per cent rolled barley for 98 days. The average initial weight of this herd was 38.46 pounds and the average final weight 113.33 pounds. Table XI shows the gains and returns from these two lots of hogs and a comparison with a similar experiment in 1916, when values are accepted as follows: Pork gain worth 7 cents a pound; grain worth 1 cent a pound; equivalent hay production of 5 tons per acre at $8 per ton, or $40 a year, which allows 17.6 cents a day per acre for pasture, figuring 227 available pasture days. In this test only 218 actual pasture days were utilized, but the remainder was made up by a small crop of hay that was harvested between the two pasture periods. Condiments, consisting of slaked coal, rock salt, and rock phosphate, were kept before each lot of hogs continually. A total of 48 pounds was eaten by the first lot and 32 pounds by the

second, which in the calculations of Table XI was figured at a value of 3 cents a pound.

These values for feed and pork gains were not prices that prevailed during the year, but may be accepted to make these results comparable with other such experiments. At the bottom of Table XI returns are also given on the basis of the prevailing prices of the year.

TABLE XI.—*Comparative results obtained by grazing two lots of hogs on alfalfa pasture supplemented with a 2 per cent grain ration on the Yuma Experiment Farm in 1916 and 1917.*

Items of comparison.	First lot.	Second lot.	Entire season.	
			1917	1916
Number of hogs per acre	23⅓	16	.....	24
Total gain per acre.....pounds..	1,869	878	2,747	4,813
Length of pasturing period.....days..	120	98	218	227
Average daily gain per acre.....pounds..	15.58	8.96	12.6	21.2
Total grain fed per acre.....do....	4,499	2,848	7,347	14,026
Grain fed per pound of gain.....do....	2.41	3.24	2.68	2.91
Gain per 100 pounds of grain.....do....	41.6	30.82	37.36	34.3
FINANCIAL STATEMENT.				
Pork at 7 cents a pound; grain at 1 cent a pound:				
Net return per acre	$83.95	$31.71	$117.55	$196.65
Daily return per acre	.699	.324	.539	.867
Cost per 100 pounds of grain (pasture rent at 17.6 cents per day)	3.64	5.30	4.18	3.75
Equivalent paid by hogs for hay per ton	27.98	15.86	23.51	39.23
Pork at 13 cents a pound; grain at 3½ cents a pound:				
Net return per acre	83.64	13.16	102.47	.....
Daily return per acre	.697	.134	.47	.....
Cost per 100 pounds of gain (pasture rent at 17.6 cents per day)	9.66	13.41	10.74	.....
Equivalent paid by hogs for hay per ton	27.55	6.58	20.49	.....

The term "net return," as used in Tables XI and XII, refers to the difference between the total values of the gains in weight and the value of grain consumed, without deducting production cost, interest on investment, or risk.

During the extreme heat of summer, when alfalfa makes less than average growth, it was evident that the hogs were not supplied with as much pasture as they could have used profitably. The pasture used in this test was on medium light soil and the alfalfa suffered badly from trampling and overpasturing at this period. Much water grass came into the damaged alfalfa stand, but the hogs did not eat the grass readily. In addition to the pasturing of this alfalfa, a small cutting of hay was harvested on August 20, amounting to 0.236 ton per acre, which, at $8 per ton, gave an additional return of $1.89 per acre, or with hay worth $24 a ton, a return of $5.67 an acre.

On November 6, the same herd of hogs which was carried through the second pasture period on alfalfa was turned into a field of mature Dwarf milo and fed no other grains. By harvesting and thrashing small plats of known area it was estimated that the Dwarf milo field yielded at the rate of 2,962 pounds of thrashed grain per

acre. The hogs were allowed access to the alfalfa pasture, but the growth was so sparse and the hogs frequented the pasture so little that no account was taken of this pasture value through this period. After a period of 14 days it was apparent that the grain was as well cleaned up as could be expected. The hogs had gained at the rate of 357 pounds of pork per acre, which denotes a loss as compared with the actual value of the grain consumed. Table XII presents the results of the milo pasturing.

TABLE XII.—*Results of hogging-down Dwarf milo on the Yuma Experiment Farm in 1917.*

Number of hogs per acre		14.6
Total gain per acre	pounds	357
Length of pasturing period	days	14
Average daily gain per hog	pounds	1.746
Calculated thrashed grain yield per acre	do	2,962
Grain fed per pound of gain	do	8.297
Gain per 100 pounds of grain	do	12.06

FINANCIAL STATEMENT.

Net loss per acre:	
Estimating grain to be worth 1 cent and pork 7 cents per pound	$4.63
Estimating grain to be worth 3½ cents and pork 13 cents per pound	57.30
Equivalent paid by hogs for grain per ton:	
Estimating pork to be worth 7 cents per pound	16.88
Estimating pork to be worth 13 cents per pound	31.33

The gains made by harvesting and feeding milo in this manner were small when compared with the results of hand feeding the same quantity of grain. The return was at the rate of $31.33 per ton for grain that was worth at least $65 per ton at the actual market price. The hogs, however, did not pass much undigested grain, as is often the case when grain sorghums are fed in large rations without being crushed. However, when the field was later irrigated without being plowed milo germinated in a thick stand over the entire field, showing that much of the grain had been lost by being trampled into the soft soil. This grain could not be profitably regained by hogs being finished for market after the grain in sight was all consumed.

GRAIN SORGHUMS.

VARIETY TEST.

One test of varieties of grain sorghums was carried on throughout 1917 on a field basis. Included in this test were several varieties which so far as known are the most valuable as compared with other varieties that have given indications of worth in former tests of smaller areas in this region. Table XIII shows the yields of these varieties compared with yields of some other varieties for a period of three years, as recorded in the report of the Yuma Experiment Farm for 1915.

TABLE XIII.—*Comparative yields of grain-sorghum varieties grown on the Yuma Experiment Farm in 1917 and in previous years.*

Variety.	Average number per plant.		Average number of filled heads per stalk.	Character of heads (per cent).		Yield of thrashed grain per acre.		
	Stalks.	Total heads.		Chaffy.	Filled.	Relation to air-dry heads.	1917	Average of 1913, 1914, and 1915.
						Per cent.	*Bushels.*	*Bushels.*
White durra	1.88	2.06	0.917	11.6	88.4	63.65	36.7	.....
Dwarf milo	2.34	2.44	.994	4.55	95.45	73.95	31.3	31.5
Dwarf hegari	3.06	3.19	1.01	2.55	97.45	82.5	29.8	.....
Feterita	2.77	5.15	1.59	14.11	85.89	65.9	29.5	28.2
Dwarf Blackhull kafir	1.55	1.6	.992	4.7	96.3	74.8	27.7	18.5
Shrock kafir	2.24	2.36	.969	3.1	96.9	75.1	26.5	.....

The one variety (White durra) which yielded more thrashed grain per acre than Dwarf milo is a tall-growing sort and requires a longer season to mature grain than any of the other varieties. It produces very large heads of grain and a heavy yield of fodder. The height to which the plants grow makes harvesting of the heads difficult, but the variety may prove valuable when utilized for silage. A plat of white durra is shown in figure 2.

P6790WI

FIG. 2.—A plat of White durra growing on the Yuma Experiment Farm in 1917.

Dwarf hegari seems to be a very desirable variety for grain production, though the plants do not become large. The grain is very uniform and the heads compact. The percentage of thrashed grain from the heads was greater than from any of the other varieties. Figure 3 shows a good plant of this variety compared with like specimens of Dwarf milo and feterita.

P6572WI

FIG. 3.—Typical plants of grain sorghum varieties grown on the Yuma Experiment Farm in 1917. From left to right: Feterita, Dwarf milo, and Dwarf hegari.

Brown kaoliang is another variety of grain sorghum which was grown on the experiment farm, but not included in this test, that may prove to be a valuable variety. The average yield per acre of several small plats was 36.6 bushels of thrashed grain.

SPACING TEST.

Dwarf milo at the present time is much more generally grown in this district than any other variety of grain sorghum. Different views are held as to what are the best cultural methods for producing this crop. The results of experiments with different spaces within the row, covering a period of three years, were presented in the last yearly report of this station. To supplement this work, similar tests were conducted during 1917 on both light amd medium types of soil, the results of which are shown in Table XIV. From this test and the results of trials in former seasons, it will be seen that the maximum yields are obtained from fields having the plants spaced about 12 inches apart in the row. Another very noticeable difference shown in the comparison of these data is the relatively lower percentage of well-filled heads on sandy soil than on medium soil.

TABLE XIV.—*Results of a spacing test of Dwarf milo grown on the Yuma Experiment Farm in 1917.*

Soil and spacing of plants in the row.	Average number per plant.		Average number of filled heads per stalk.	Character of heads (per cent).		Yield of thrashed grain.	
	Stalks.	Total heads.		Chaffy.	Filled.	Per acre.	Relation to air-dry heads.
Medium heavy soil:						*Bushels.*	*Per cent.*
6 inches	2.09	2.07	0.974	1.7	98.3	32.2	74.6
12 inches	2.61	2.59	.991	1.3	98.7	36.2	75.8
18 inches	2.63	2.82	1.07	5.1	94.9	24.8	76.8
24 inches	2.39	2.47	.974	2.6	94.2	25.7	75.8
Light soil:							
12 inches	2.1	2.33	.972	12	88	32.2	70.4
18 inches	2.15	2.58	1.03	14.2	85.8	32.1	[a]73.6
24 inches	3.34	3.68	1.0	9.2	90.8	30.5	67.5

[a] The actual percentage in this case was not obtained. The figure used is an average of all Dwarf milo samples of the year.

SEED PRODUCTION.

In order that a strain of uniform and well-acclimated seed of Dwarf milo might be established and maintained on the Yuma project, some careful selection and breeding work has been carried on at this station for the past four years. It seems that the strain of seed that has been developed is perhaps superior to any other Dwarf milo on the project at present, and a quantity will be distributed to growers who desire to improve their planting seed. Figure 4 shows an increase field of this grain.

OIL CROPS.

The tests conducted with oil crops on the experiment farm during 1916 were in most cases repeated during 1917. Cottonseed, although a by-product of the cotton-fiber industry, has during the past years been an item of much importance. The total value of cottonseed produced on the entire project, as recorded in Table III, was

$329,020. This is the only oil crop as yet that has been produced commercially.

P678SWI

FIG. 4.—A field of Dwarf milo grown from well-selected seed on the Yuma Experiment Farm in 1917.

TABLE XV.—*Yields of flax variety C. I. No. 3 grown in date-of-planting and rate-of-seeding tests on the Yuma Experiment Farm in 1917.*

Date and rate of seeding.	Seeds per boll.		Yield per acre (bushels).	
	Average number	Weight (grams).	1917	Comparable test in 1916.[a]
Date-of-planting test (in rows 30 inches apart):				
November 25	8.3	0.04	14.8	6.0
December 1	8.05	.025	19.4	6.2
December 15	8.5	.0325	26.1	6.3
January 2	8.1	.0325	24.5	8.0
January 15	8.75	.055	23.5	7.4
February 1	8.3	.035	23.5	5.4
Rate-of-seeding test (sown broadcast, Nov. 29):				
18 pounds	.....	.....	8.98	.....
25 pounds	.....	.....	10.05	.....
30 pounds	.....	.....	10.76	.....
40 pounds	.....	.....	10.9	.....
50 pounds	.....	.....	10.85	.....
60 pounds	.....	.....	10.66	.....
Average	.....	.....	10.53	[b] 2.93

[a] The variety grown in the time-of-planting test in 1916 was C. I. No. 13.
[b] This figure is the average yield of seven of the best varieties grown in a broadcast sowing in 1916, seeded at the rate of 30 pounds per acre.

FLAX.

More attention has been given to flax experiments during the past year than to any other of the oil crops. Plantings were made on larger plats, and while no exceedingly high yields were obtained

all were more regular than in past seasons. Table XV shows the behavior of one of the best adapted varieties (C. I. No. 3)[1] under various culture tests.

The date-of-seeding test included plantings made in rows 30 inches apart at intervals of 15 days, ranging from November 25 to February 1. It was indicated by this test, as by a similar test conducted during the previous year, that the largest seed yields can be produced from plantings made late in December or early in January.

All broadcast plantings made very much better yields than those produced by this method of culture in past seasons. This was partly due to the fact that the soil of the plats used was of a lighter type

P6508WI

FIG. 5.—Plats of flax in flower, sown broadcast on the Yuma Experiment Farm in 1917.

than in those planted in 1916. A silt soil that seals tightly about the plant stems produces profitable yields of flaxseed only when the crop is planted in rows that may be cultivated after each irrigation, but cultivation is not necessary when the crop is planted broadcast. The very light sandy soils do not produce good seed yields. The differences in yield among plantings seeded at rates of 25 to 60 pounds per acre were not great, and it would seem from this trial that 25 pounds of seed per acre is sufficient. The average yield of broadcast plantings of 10.53 bushels per acre may be compared with the yields from this same variety grown in row tests, which were 8.97 and 11.65 bushels per acre. This is the first season when the seed yields of the broadcast plantings have equaled those of row plantings. In a varietal test of 23

[1] All flax varieties have been carried under a series of numbers assigned by the Office of Cereal Investigations, in cooperation with which office these tests are conducted.

varieties grown in nursery rows 30 inches apart, 8 varieties produced more than 15 bushels of seed per acre, while 20 produced more than 10 bushels per acre. The highest of these yields was 19.9 bushels. Nine of the best of these same varieties, as determined by previous trials, were planted in rows 30 inches apart on a field basis and produced an average of 8 bushels per acre. It is evident that a space between rows of 30 inches is more than is necessary to allow cultivation and still produce a maximum yield. Figure 5 shows several plats of flax that was sown broadcast, and figure 6 shows variety rows of flax.

P6509W1

FIG. 6.—Variety rows of flax grown on the Yuma Experiment Farm in 1917.

MISCELLANEOUS OIL CROPS.

Most of the tests conducted with castor beans, peanuts, and soy beans described in the last report of this station as oil crops were repeated in 1917 with similar results.

MISCELLANEOUS CROPS.

A number of miscellaneous forage crops that have been grown in cooperation with the Office of Forage-Crop Investigations were described in the report of this station for 1916, most of which were grown again during 1917. Only those of which more definite data have been obtained are again referred to in this paper.

FORAGE SORGHUMS.

Four varieties of forage sorghums which are among the best of a large number of varieties tested in previous years were grown in a cooperative experiment with the Yuma office of the United States

Indian Service for the production of sirup. The data relating to yields, as supplied by that office, are shown in Table XVI. Each variety of sorghum was cut and pressed at the time that the stalks seemed to contain the most sugar.

TABLE XVI.—*Sirup produced from sorghum varieties grown in cooperation with the United States Indian Service on the Yuma Reclamation Project in 1917.*

Variety.	Plat area (acre).	Yield (gallons).		Rank as to earliness.
		Per plat.	Per acre.	
Gooseneck ("Texas Seeded Ribbon")	1.0	200	200	4
White African	.1875	33	176	3
Honey	.1875	28	149	2
Sumac	.4	28	70	1

The Gooseneck ("Texas Seeded Ribbon") and White African varieties are both very desirable for sirup production. The sirup from the latter variety was a little lighter in color and of a more delicate flavor than that from any other variety. Sorghum grown on soil carrying much white alkali has been found undesirable for sirup production, as the sirup retains a salty flavor.

FIELD PEAS.

Four varieties of field peas already found to be very good for forage production were planted broadcast in plats on November 28, 1916, to produce seed yields. The results of this test are shown in Table XVII.

TABLE XVII.—*Seed yields of varieties of field peas grown on the Yuma Experiment Farm in 1917.*

Variety.	Date.		Length of season.	Seed yield per acre.	Rank in forage production.	
	Planted.	Mature.			1916	1917
			Days.	*Bushels.*		
Amroti	Nov. 28, 1916	May 4, 1917	157	15.45	3	2
Bangalia	do	Apr. 30, 1917	153	12.35	4	4
Scotch Blue	do	May 25, 1917	178	9.38	2	1
Liberty (Kaiser)	do	May 20, 1917	173	9.03	1	3

Other varietal tests of field peas grown during this season included 40 different varieties. Among this lot none has proved to be more valuable as a winter green-manure crop than the four listed in Table XVII. Although the Scotch Blue and Liberty varieties generally produce the heaviest green-manure yields, it can not be expected that either of these sorts will produce profitable seed yields regularly. The rather late, cool spring of 1917 was favorable for

the seed production of these varieties. The Amraoti and Bangalia varieties in all trials have produced fair seed yields, which is an important factor if a local supply of seed is to be maintained for this green-manure crop. Figure 7 shows plats of peas of the Amraoti and Liberty varieties.

P6510W1

FIG. 7.—Two plats of field peas grown on the Yuma Experiment Farm in 1917. Varieties: Liberty at the left, Amraoti at the right.

TANGIER PEAS.

The Tangier pea is an annual winter legume in this climate and in many characters is similar to the garden sweet pea, but more vigorous in growth. Six different selections of this plant were grown during 1917 in rows 3 feet apart, but none produced yields equal to the best varieties of field peas.

CHUFAS.

There were two strains of chufas grown at the experiment farm for test, principally as a tuber crop. One of these varieties yielded at the rate of 2.1 tons of tubers per acre and also produced 2 tons of air-dried hay per acre. The yields were much greater on medium soil than on sandy soil, both in forage and tubers. These plats were planted early in May in rows 3 feet apart and were cultivated after each irrigation similarly to all row crops. The mature growth of the best plats was 28 inches high and filled the space between rows. A plat of chufas (S. P. I. No. 43578) is shown in figure 8.

RICE.

Several inquiries have been received from local farmers as to the possibility of growing rice on some areas of heavy silt soils on the Yuma project. Since rice has been tested without success on the experiment farm, a descriptive paragraph is included in this report. In 1915, and again in 1916, five different varieties of rice were planted during April. A fair germination was secured, but the plants turned yellow and began to die when about 6 inches high. At the same time the plats became badly infested with water grass and the tests were abandoned. The cause for the failure of the plats was not

P6537WI

FIG. 8.—A plat of chufas (S. P. I. No. 43578) grown on the Yuma Experiment Farm in 1917.

further determined. The most discouraging feature of attempting rice culture on the Yuma project is the very probable danger that the water table of areas adjacent to the land being heavily irrigated for rice would be raised to a level that would jeopardize all other crops. This condition would likely follow because of the very pervious sandy subsoil which underlies these areas.

PASTURING BERMUDA GRASS WITH CATTLE.

During the year 1916 a pasturing test of cattle on alfalfa was conducted on a 4-acre pasture of very sandy soil. At the close of this test the alfalfa showed distinctly the injurious effects of overpasturing and trampling and was so badly infested with Bermuda grass that it was deemed desirable to carry this area through another season as a Bermuda grass pasture. The field was fenced in two divisions in order to allow alternate pasturing and irrigation, and at no time was the stock allowed to pasture on wet ground. On May 28 eight head of yearling Holstein steers of an average weight of 606 pounds were placed on this pasture. Steers of a beef type were preferred,

but desirable animals of such breed could not be secured on the project at that time. The animals used, however, were a good even herd in fair condition and represented the type of steers being produced locally from dairy cows. The gains from this pasture were not as large as had been expected, but were gradual until late September. On September 24, at the close of a 126-day pasturing period, a total gain of 907 pounds was made. With beef gains worth 8 cents a pound, the net returns per acre equalled $19.74. During the next period of 56 days closing November 19, a total loss of 272 pounds was recorded on the entire herd. This undoubtedly indicates the period of little growth of Bermuda grass, which is always noticeable when cool nights occur in the autumn.

PASTURING SHEEP ON IRRIGATION DITCHES.

The maintenance of irrigation ditches on the Yuma project has been very expensive from two operations, namely, the control of vegetation in ditches and the removal of deposits of silt. Both operations are essential in keeping ditches open. It has been found that the cost of this maintenance may be much reduced by pasturing with sheep where fences can be provided. A test of this nature was

P6799W1

FIG. 9.—Section of an irrigation ditch on the Yuma Experiment Farm, showing the excellent condition in which the ditch is maintained by being pastured by sheep.

conducted in cooperation with the local office of the United States Reclamation Service on the experiment farm in 1917. The area pastured was the main irrigation ditch on the north side of the farm and one lateral ditch. The fence established was 5 feet high and thoroughly sheep and dog proof. This ditch was approximately one-half mile long and well grown with Bermuda grass on the inside and quite well covered in various places on the outside of the banks. It is estimated that the area actually pastured was about 2½ acres. The sheep placed

on pasture were 31 Tunis and Tunis-Shropshire crosses, which averaged 76 pounds in weight at the beginning of the experiment, and consisted of 13 head of ewes, 17 head of medium-sized lambs, and one ram. The sheep kept the ditches free from obstructing vegetation the entire season and also grazed the grasses so short that the opportunity for the settling and depositing of silt was reduced to a minimum. At the close of the year only a small part of the usual silt deposit had built up in the bottom of the ditch. No labor was needed to cut weeds and tall grass, and the ditch was at all times in excellent condition for the flow of irrigation water. The weights of this flock of sheep at different periods of the pasturing season are presented in Table XVIII, and a section of the ditch is shown in figure 9.

TABLE XVIII.—*Weights of sheep pastured on Bermuda grass grown on the banks of irrigating ditches on the Yuma Experiment Farm in 1917.*

Items of comparison.	Dates and results.						
Weighing:							
Initial	May 25	June 25	July 19	Aug. 22	Sept. 24	June 25	May 25
Final	June 25	July 19	Aug. 22	Sept. 24	Oct. 30	Oct. 30	Oct. 30
Number of sheep	30	30	30	30	31	31	31
Pasturing period.....days	31	24	34	33	36	127	158
Total gain.....pounds	260	.....	.....	.....	.....	.....	135
Total loss.....do	.....	60	12	23	30	125	.....
Average gain per day per head.....do	0.2796	.....	.....	.....	.....	.....	.....
Average loss per day per head.....do	.....	0.0833	0.0118	0.0232	0.0269	.....	.....
Financial statement:							
Mutton gains worth 13 cents per pound	$33.80	.....	.....	.....	.....	.....	$17.55
Net returns (120 pounds wool at 50 cents, 15 pounds mutton at 13 cents)	.....	.....	.....	.....	.....	.....	61.95

Table XVIII shows that a total net gain of 135 pounds was made for the entire period of pasture. Growers who are familiar with the production of sheep in this climate do not expect heavy gains during the summer months of high temperatures. Also only small gains can be expected from mature ewes. Although the gain made by this flock was small, it represents profit because the maintenance of ditches more than compensated for the expense involved in handling the sheep. If it were to be conservatively estimated that 120 pounds, or about 4 pounds per animal, of the 135-pound gain produced from the entire herd was wool worth 50 cents a pound, a return of $60 would have been realized. With mutton gains worth 15 cents a pound, there would be an additional return of $1.95, or a net return of $61.95, in addition to having the irrigation ditches kept clear of obstructing vegetation and relatively free from the deposit of silt.

IRRIGATION REQUIREMENTS.

The water requirements of the entire Yuma project for the year 1917, as accounted for by the United States Reclamation Service, are given in brief in Table XIX. Water accounted for as unused is that

lost by seepage and evaporation from canals and also the amount of water turned back into the Colorado River through wasteways. The average amount of water applied to each acre irrigated on the project was 3.7 acre-feet, as compared with 3.2 acre-feet during 1916.

TABLE XIX.—*Water requirement for the Yuma Reclamation Project for the year 1917.*

Month.	Water measurements.					
	Total diverted.	Unused.	Delivered to farms.			
			Total.	Part of total.	Per acre irrigated.	
					1917	1916
	Acre-feet.	*Acre-feet.*	*Acre-feet.*	*Per cent.*	*Acre-feet.*	*Acre-feet.*
January	8,010	5,938	2,052	1.6	0.06	0.07
February	21,629	14,244	7,385	5.4	.20	.12
March	31,039	17,510	13,529	9.9	.37	.28
April	32,370	19,038	13,332	9.8	.36	.31
May	36,362	20,868	15,494	11.3	.42	.33
June	39,743	23,433	16,310	11.9	.44	.45
July	39,429	22,397	17,032	12.7	.46	.39
August	41,085	22,400	18,986	13.9	.48	.48
September	37,512	21,530	15,952	11.5	.43	.36
October	23,047	13,074	9,923	7.4	.28	.22
November	18,711	15,807	2,904	1.7	.09	.12
December	8,660	4,737	3,933	2.9	.11	.07
Total for year	337,547	201,006	136,541	100	3.7	3.20

ORCHARD FRUITS.

DATES.

During the spring of 1917, 312 Deglet Noor seedling palms were transplanted to orchard positions from nurseries. There are now 1,796 palms in orchard planting, 1,317 along roadways, and 3,568 growing in nurseries ready to be moved. No additional information of importance relating to seedling date palms at this station has developed since the report of 1916.

DECIDUOUS FRUITS.

In the spring of 1917, 72 additional trees were planted in the variety orchard of deciduous fruits. These include 2 varieties of peaches, 7 apricots, 2 cherries, 6 plums, 7 apples, 1 quince, 3 persimmons, 1 olive, 9 almonds, and 2 jujubes. Of this list, there were 15 that did not start or died during the first few months. Some of the varieties of the different fruits included in this orchard that were planted in 1913 and 1914 died during 1917. A list of these varieties is shown in Table XX. It has not been definitely ascertained why these trees were lost, but it may have been due to root troubles caused by alkaline soil combined with a medium-high water table. The depth to ground water beneath this orchard varies according to the season of irrigation and the height of the Colorado River, but generally it is about 8 feet from the soil surface.

TABLE XX.—*Results of experiments with deciduous fruit trees in the orchard test on the Yuma Experiment Farm in 1917.*

Kind and variety.	Age of tree (years).	Number of trees.		
		Originally planted.	Died.	Living.
Peach:				
Carman	3	2	1	1
Alexander	4	2	1	1
Triumph	4	1	1	.....
Victor	3	2	1	1
Haney	4	2	1	1
Pallas	4	2	2	.....
S. P. I. No. 32373	3	2	2	.....
S. P. I. No. 32372	4	2	1	1
S. P. I. No. 32377	4	1	1	.....
S. P. I. No. 32380	3	2	1	1
Early Crawford	4	1	1	.....
Muir	4	2	1	1
Bell October	3	3	1	2
Peerless	3	4	2	2
Nectarine, S. P. I. No. 34684	3	2	2	.....
Apricot, Royal	3	2	2	.....
Plum, Clyman	3	2	1	1
Prune, French	4	2	1	1
Plumcot, Rutland	4	2	2	.....
Cherry:				
Bing	4	2	1	1
Early Purple	4	2	1	1
Pear, Clapp Favorite	3	1	1	.....
Crab apple, Whitney	3	2	1	1
Persimmon:				
Yenran	3	1	1	.....
Okame	4	1	1	.....
Pistache:				
Large red Aleppo	4	1	1	.....
Sicilian	4	4	4	.....
Total	.....	52	36	16

In Table XXI are given the yields from trees of various varieties in this orchard that produced fruit during 1917, and views showing the tree development are presented in figures 10 and 11.

P6684W I

FIG. 10.—A 5-year-old tree of the Tilton apricot in the deciduous-variety orchard on the Yuma Experiment Farm in 1917.

TABLE XXI.—*Yields and performance of varieties of deciduous fruit trees on the Yuma Experiment Farm in 1917.*

Kind and variety.	Tree No.	Age of tree (years).	Date of—			Yield (pounds).
			Flowering.	First ripe.	Last ripe.	
Apricot:						
Tilton	B-3	3	Mar. 5	June 13	.....	11.5
Moorpark	B-5	3	...do.....	...do.....	.....	16
Blenheim	B-6	3	...do.....	...do.....	.....	21
Do	N-5	4	...do.....	...do.....	June 23	116.5
Royal	N-4	4	Mar. 6	...do.....	...do.....	77
Do	N-6	3	Mar. 5	June 15	June 26	39.5
Tilton	N-7	4	Mar. 6	June 21	...do.....	79
Do	N-8	4	...do.....	...do.....	...do.....	76
Royal	N-3	3	...do.....	June 23	.....	10
Hemskirke	N-2	4	Mar. 7	...do.....	.....	9
Peach:						
Alexander	H-11	4	Mar. 14	June 15	.....	4
Do	H-12	4	Mar. 15	...do.....	.....	4.5
Japan Dwarf	F-8	3	Mar. 7	...do.....	June 23	12
Triumph	G-14	4	Mar. 15	June 16	...do.....	18
Do	G-15	3	...do.....	June 18	.....	19
Do	G-8	3	...do.....	June 23	.....	9
Rivers	F-17	3	Mar. 9	July 12	July 24	11.5
Imperial	G-21	4	Mar. 3	...do.....	.....	41.5
Mamie Ross	G-16	4	Mar. 15	...do.....	July 31	79
Do	G-17	4	...do.....	...do.....	...do.....	91.5
Carman	F-3	3	Mar. 14	July 14	July 19	8.5
Do	F-4	3	...do.....	...do.....	July 21	2
Victor	F-22	3	Mar. 10	...do.....	July 31	13
Hale Early	G-22	4	Mar. 13	...do.....	...do.....	4
Honey	G-12	4	Feb. 28	...do.....	July 19	31.5
Mexican Seedling	G-9	4	...do.....	...do.....	...do.....	42
Victor	F-21	3	Mar. 10	July 17	July 23	3
Ceylon	G-1	4	Feb. 10	July 24	Aug. 16	53
Do	G-2	4	...do.....	...do.....	...do.....	59.5
Mexican Seedling	G-4	4	Feb. 28	July 31	Aug. 9	171
Muir	H-5	4	Mar. 22	Aug. 9	Aug. 16	5
Champion	H-16	4	Mar. 16	...do.....	Aug. 25	33.5
Elberta	H-20	4	Mar. 11	...do.....	Sept. 1	60.5
Mexican Seedling	G-5	4	Feb. 28	Aug. 11	Aug. 28	85
Champion	H-15	4	Mar. 15	Aug. 13	Aug. 25	45
Climax	G-18	4	Feb. 28	...do.....	...do.....	28
Do	G-19	4	Mar. 2	...do.....	...do.....	21.5
Elberta	H-19	4	Mar. 11	...do.....	Sept. 1	38
Mexican Seedling	G-3	4	Feb. 28	Aug. 22	.....	17
S. P. I. No. 32378	E-15	3	Feb. 27	...do.....	Sept. 1	21.5
Late Crawford	H-1	4	Mar. 17	...do.....	Aug. 25	6
Do	H-2	4	Mar. 15	...do.....	...do.....	4
S. P. I. No. 32375	I-12	3	Feb. 26	Sept. 1	Sept. 6	74
S. P. I. No. 32378	E-16	3	Feb. 27	...do.....	.....	59
Bell October	E-1	3	Mar. 2	...do.....	Sept. 17	28.5
Do	E-2	3	...do.....	...do.....	...do.....	30
Indian Cling	E-7	3	Mar. 15	...do.....	Sept. 6	9
Do	E-8	3	Mar. 14	...do.....	...do.....	7
Early Imperial	E-11	3	Mar. 7	...do.....	...do.....	9
Onderdonk	F-13	3	Feb. 28	...do.....	...do.....	36
Do	F-14	3	...do.....	...do.....	...do.....	9
Lovell	H-17	4	Mar. 11	...do.....	Sept. 17	20.5
Do	H-18	4	...do.....	...do.....	...do.....	24
Orange Cling	I-4	4	Mar. 15	Sept. 6	.....	2
Salwey	H-3	4	Mar. 17	Sept. 29	Oct. 6	5
Do	H-4	4	...do.....	...do.....	...do.....	5
Plum:						
Shiro	K-5	4	Mar. 5	June 15	June 18	36
Do	K-6	4	...do.....	June 18	.....	47
Santa Rosa	K-9	4	Feb. 26	June 23	.....	24
Gonzales	L-18	3	Feb. 28	...do.....	.....	3
Do	L-19	3	Feb. 27	...do.....	.....	6
Do	L-20	3	...do.....	...do.....	.....	3
Burbank	D-18	3	Mar. 7	June 25	.....	1
Climax	K-13	4	Mar. 15	...do.....	.....	16
Do	K-14	4	Mar. 17	...do.....	.....	30
Satsuma	L-9	4	Mar. 5	June 28	.....	.5
Quince:						
Smyrna	M-18	3	Mar. 15	Oct. 6	.....	7
Do	M-19	3	Mar. 16	...do.....	.....	9
Pineapple	M-20	3	Mar. 14	...do.....	.....	3
Do	M-21	3	...do.....	...do.....	.....	4
Rea	M-22	3	Mar. 15	...do.....	.....	3
Do	M-23	3	Mar. 14	...do.....	.....	6
Orange	W-23	3	Mar. 13	...do.....	.....	1
Do	W-22	3	...do.....	...do.....	.....	3

The seedling Smyrna-Adriatic fig hybrids being grown at the experiment farm suffered practically no frost injury during the winter of 1917. There were 275 trees that matured fruit, of which 39 were considered of promising quality.

P6700W1

FIG. 11.—A fruit-bearing Zengi persimmon tree on the Yuma Experiment Farm in 1917.

The seedling pomegranates under test at this station produced a large crop of fruit during the season. It was found that about 36 per cent of this fruit was more or less damaged by the undetermined fruit injury which is often present in pomegranate fruit in the Southwest. In 1916 there were 327 plants in this seedling orchard, of which 88 of those producing the least desirable fruit were removed in 1917. Of the remaining plants, 89 per cent produced fruit this season, among which there are 17 that have produced fruit of sufficiently desirable quality to deserve further study. The pomegranate is more resistant to alkali injury than most other fruits. This is shown in the deciduous fruit orchard, where pomegranate bushes are growing after having been transplanted to positions in the orchard where peaches, plums, and prunes had been tried twice and all had succumbed to alkali injury. A view of these plants is shown in figure 12.

P6781W1

FIG. 12.—Pomegranate bushes growing on soil on the Yuma Experiment Farm where other deciduous fruits had been killed by white alkali.

CITRUS AND KUMQUAT FRUITS.

During June, 1914, several varieties of orange, lemon, grapefruit, and kumquat were planted to orchard positions on the experiment farm in order that definite data might be secured regarding the behavior of these citrus fruits under valley conditions. These trees were all protected by covering with sorghum stalks during the first two winters, since it was known that the probable minimum temperatures would be too severe for young citrus trees. All trees were again protected in a similar manner during the third week of December, 1916, but it happened that the lowest temperature of the entire winter, which was 20° F. above zero, occurred on December 8, before the trees were protected. The injury resulting from this freeze varied greatly among the different varieties and in some cases is difficult to understand. Some supposedly frost-tender trees were not badly damaged, while others recognized as more hardy were killed to the ground. All grapefruit and orange trees except those of the Ruby orange variety were killed. The Eureka lemon trees were killed, while both Lisbon and Villafranca trees had only the growing tips of the branches frozen. Until this freeze the varieties all seemed equally vigorous. Illustrations of these trees are shown in figures 13, 14, and 15. The Ruby orange, however, is known to be one of the most hardy varieties. A tree of this variety is shown in figure 16.

P5797W1

FIG. 13.—Eureka lemon tree six months after planting on the Yuma Experiment Farm in 1914.

P5796W1

FIG. 14.—Lisbon lemon tree six months after planting on the Yuma Experiment Farm in 1914.

The only other variety of citrus fruit not damaged was the kumquat. It may be that the unexpected difference in frost resistance as indicated among some of these varieties of citrus trees was partly due to the influence of the different species of rootstocks on which these trees were growing, but this has not been definitely determined. The results of this test thus far reaffirm the belief that citrus plantings can not be expected to endure through the winter temperatures that often occur in unprotected locations in the valleys on the Yuma project.

P6593WI

FIG. 15.—Eureka lemon tree dead after the freeze of December, 1916, with a Lisbon lemontree in the background uninjured, on the Yuma Experiment Farm in November, 1917.

GRAPES.

A large number of grape varieties have been planted in a varietal test in vineyard form on the experiment farm during the past four years. Some of these varieties have produced profitable fruit yields, while others have not yet begun to bear. A record of these yields for 1916 and 1917 is presented in Table XXII.

TABLE XXII.—*Yields of varieties of grapes grown on the Yuma Experiment Farm in 1916 and 1917.*

Variety.	Year planted.	Dates of ripening.		Number of vines per acre.	Average yield (pounds).		
					Per vine.		Per acre, 1916 and 1917.
		1916	1917		1916	1917	
Sultanina (*Thompson Seedless*)	1913	June 19	July 10	435	9.1	3.62	2,766
Sultanina Rosea	1914	...do...	.....	435	.83	.....	361
Sultana	1913	July 3	July 10	435	17	8.50	5,046
Black Malvoisie	1914	...do...	Aug. 2	435	1.5	3.87	1,165
Rose of Peru	1913	July 28	.....	435	7	.....	3,045
Do	1914	July 7	Aug. 2	435	1.5	.5	435
Malaga	1914	...do...	...do...	435	4.7	3	1,675
Muscatelle Fino	1913	July 8	...do...	435	4.75	4	1,900
Mission	1914	July 7	July 21	435	3.37	.5	839
Dattier de Beyrouth	1914	July 11	.....	435	2	.....	870
Purple Damascus	1914	...do...	.....	435	.5	.....	218
Black Morocco	1913	...do...	Aug. 2	435	5.75	1	1,465
Muscat of Alexandria	1914	...do...	...do...	435	1.5	3.5	1,087
Muscat	1914	...do...	...do...	435	.66	2.66	722
Black Cornichon	1913	July 26	.....	435	4.37	.....	1,900
Almeria	1914	Aug. 16	.....	435	.33	.....	143
Muscat Albardiens	1916	.....	July 10	435	.33	.....	143
Black Hamburg	1913	.....	Aug. 2	435	1.00	.....	435
Black Prince	1913	.....	...do...	435	1.75	.....	761

STRAWBERRIES.

The culture of strawberries found most desirable at this station was described in the report of last season. In connection with cultural tests a variety test has been attempted, the results of which are given in Table XXIII.

TABLE XXIII.—*Yields of varieties of strawberries grown on the Yuma Experiment Farm in 1917.*

Variety.	Planted, 1916.	Dates of ripening, 1917.			Yield per acre (quarts).
		First fruits.	Most of crop.	Last fruits.	
Ozark	Feb. 15	Apr. 4	Apr. 14	May 11	3,757
Gold Dollar	Feb. 23	...do.....	Apr. 26	June 12	2,940
Ettersburg No. 80	...do.....	...do.....	...do.....	...do.....	1,686
Marshall	Feb. 15	Apr. 7	May 1	...do.....	1,154
Wilson	...do.....	Apr. 14	...do.....	May 18	1,153
Ettersburg No. 112	Feb. 23	Apr. 7	Apr. 28	May 11	915
Magoon	Feb. 15	Apr. 14	May 1	June 12	835
Arizona	Feb. 14	Apr. 4	...do.....	...do.....	736
Moise	Feb. 23	Apr. 7	Apr. 28	...do.....	607
Oregon	...do.....	...do.....	May 1	...do.....	537
Clark	Feb. 15	Apr. 4	Apr. 26	June 1	218

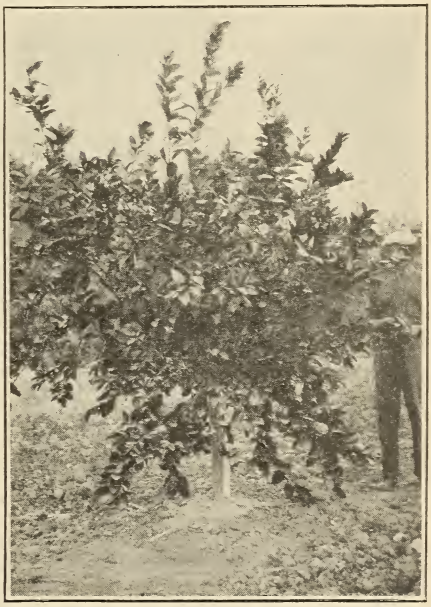
Since the plats used in this test were not of a uniform type of soil, another planting, including the best of these varieties, has already been made for further comparisons.

VEGETABLES.

In addition to the data on truck growing that have been published in previous reports of this station, further tests of a few important vegetables are here reported.

BEANS.

It has been stated in former reports that the only kinds of commercial dry beans that are known to be reliable for summer plantings in this vicinity are tepary, Blackeye, and Pink. The tepary and Pink beans were planted on July 19, in a space-between-row test, but only the tepary produced a sufficiently good stand to continue the test. Rows were planted 22, 30, and 36 inches apart. All were mature and harvested on November 15, producing yields per acre as



P6589WI

FIG. 16.—Ruby orange tree growing on the Yuma Experiment Farm in 1917.

follows: 22-inch rows, 1,065 pounds; 30-inch rows, 900 pounds; and 36-inch rows, 975 pounds. Rows less than 22 inches apart can not easily be cultivated with horse cultivators. Nine other commercial varieties of dry beans were planted in a variety test on the same date. Good stands were not secured, and all except the tepary and Blackeye succumbed to the high temperatures while the plants were very small.

PEAS.

The yields of the best varieties of peas found adapted to this climate are recorded in Table XXIV, showing the results of comparable trials for two years. The 1917 test was planted on October 6, but did not produce peas before frost. It often happens that a small yield of peas is produced before frost, while the main crop follows in the spring.

TABLE XXIV.—*Yields of varieties of green peas grown on the Yuma Experiment Farm in 1916 and 1917.*

Variety.	Dates of maturity.			Yield per acre (pounds).		Average yield per acre, 1916 and 1917.	
	First picked.	Main crop.	Last picked.	1917	1916	Pounds.	Tons.
Pride of Cahuenga	Mar. 23	May 1	May 1	9,090	10,123	9,606	4.8
Yorkshire Hero	Mar. 24	Apr. 16	...do	8,094	8,887	8,490	4.42
Dwarf Telephone	Mar. 27	...do	...do	5,382	10,857	8,119	4.06
Little Marvel	Mar. 17	Mar. 17	...do	7,585	.....	7,585	3.79
Premium Gem	Mar. 24	Apr. 16	...do	7,361	6,282	6,821	3.41
American Wonder	.....	.....	.....	.....	5,427	5,427	2.71
Nott's Excelsior	Mar. 17	Apr. 16	May 1	6,922	3,782	5,352	2.67
Stratagem	Mar. 27	Apr. 24	...do	4,417	.....	4,417	2.2
Gradus	.....	.....	.....	.....	3,609	3,609	1.85
Alaska	Mar. 17	Mar. 17	May 1	2,577	.....	2,577	1.28

ONIONS.

In order to make further comparison of the value of locally grown onion seed with that of imported seed of the same varieties, several beds were planted with alternate rows of seed grown at the experiment farm and seed purchased from commercial seed houses. The two varieties found most valuable in this climate, White Bermuda and Crystal Wax, were both included in this test. These plantings were made late in September and early in October and were mature on June 5. The results of the test show an advantage of yield in favor of the locally produced seed of each variety and also a lower percentage of undesirable plants which produced seed stalks. Only slight differences in yield were shown between beds of the two varieties. Further plantings have already been made, to continue through 1918 the experiments in seed production that were started at this station in 1916. The results of these tests and also of onion-bulb production have been presented in preceding reports.

GARLIC.

Garlic can be grown in the garden by about the same methods that are required for the production of onions by sets. It is a plant that endures winter frosts in this climate without injury and may be planted during September. Either the entire bulbs are planted or the bulb is divided into the bulblets, or cloves, of which it is composed and these cloves planted in rows. The production of garlic by these two methods of propagation was compared in plantings made in the station garden on September 28. Plantings were made in beds 3½ feet wide with a row on each side of the bed. The whole bulbs were planted 12 inches apart in the row, while the cloves were spaced 4 inches apart. The clove plantings were harvested on June 9, yielding at the rate of 4,929 pounds per acre, while the whole bulb planting was not mature until June 29 and yielded 6,846 pounds per acre. Although the whole bulb planting produced the heaviest yield, the bulbs produced were smaller and not as uniform in size as those grown from the cloves. Much less seed is required when the cloves are planted.

TOMATOES.

A test to determine the best methods of starting tomato plants for transplanting to the field, along with a comparison of varieties, was conducted during the past season. From trials carried through other years, information was available to permit the selection of 11 of the most promising varieties adapted to local conditions; these were used in this test. On January 4 seed was sown by the ordinary method in a hotbed and also planted in paper pots placed in the hotbed. All plantings in pots were thinned to one plant to a pot. About one month from the time of planting, some of the plants from the flat planting in the hotbed were potted and placed in a coldframe. On April 3, after all danger of frost was past, all plants were transplanted to the field on beds 5 feet wide with a row on one edge of the bed. The tall-growing sorts were placed 4 feet apart in the row and the more dwarf varieties at a space of 3 feet between plants in the row. Plants grown in the hotbed at this date had made the greatest growth, the dwarf varieties ranging from 4 to 10 inches in height and the taller types from 10 to 14 inches. The plants in the coldframe made less top growth, but developed a large root system. Irrigations were applied through the furrows between beds. After the plants had become deeply rooted and well started in the field, the earth was plowed toward the plants on the furrow side of the row. By this means the plants were then in the center of the beds, allowing better protection to the roots from the sun and providing dry soil where the vines and fruit rested. Frequent light irrigations continued to be applied in the furrows between beds. The earliest ripe tomatoes were picked on June 18 and others were available until

July 25. No important differences in the time of maturing were noted among the plants started by the three different methods, but the differences in yield were very pronounced. Those plants grown in pots in the hotbed produced an average of 40 per cent greater yields than those in ordinary beds in the hotbed and 42 per cent more fruit than plants transplanted to pots and placed in the coldframe. The result of this test is shown in Table XXV.

TABLE XXV.—*Yields of tomato plants started by different methods on the Yuma Experiment Farm in 1917.*

Variety.	Dates of ripening.			Yield per acre (pounds).				Rank as to average yield.
	First picked.	Main crop.	Last picked.	Hotbed plants.	Coldframe pots.	Hotbed pots.	Average.	
A. and M. First Early	June 18	July 25	Aug. 1	16,775	10,218	20,159	15,711	1
Quarter Century	June 21	July 28	Aug. 24	8,720	7,364	18,909	11,664	3
Chalk's Early Jewel	June 18	July 16	Aug. 1	6,100	6,165	18,081	10,115	6
Dwarf Stone	June 23	July 25	Aug. 24	6,783	8,720	15,636	10,379	5
Matchless	July 5	July 20	Aug. 6	7,625	8,453	15,581	10,553	4
June Pink	June 18	July 25	Aug. 1	11,818	9,709	14,688	12,072	2
Dwarf Champion	June 21	...do....	Aug. 6	7,364	7,500	14,545	9,803	7
Hummer Globe	June 18	...do....	Aug. 24	5,816	4,008	12,921	7,582	9
Dwarf Giant	July 9	July 23	Aug. 1	3,090	15,163	5,062	7,772	8
Stone	....do....	July 28	....do....	7,298	2,244	4,142	4,561	10
Earliana	June 18	July 20	....do....	4,945	2,353	2,078	3,125	11
Average of each method	.....	.....	.....	7,848	7,445	12,891	.....	.....

Any of the first six varieties included in Table XXV are very reliable for planting in this region and have been found desirable because of the excellent quality of fruit produced and their relative freedom from decay and sunburn, as well as for their greater productiveness.

CUCUMBERS.

The culture of cucumbers for local production was considered in the 1916 report of this station, but without a specific comparison of varieties. During the past season the following varieties produced yields as stated in Table XXVI.

TABLE XXVI.—*Yields of varieties of cucumbers grown on the Yuma Experiment Farm in 1917.*

Variety.	Date planted.	Dates of gathering.			Yield per acre (pounds).		
		First picked.	Main crop.	Last picked.	Large.	Medium.	Total.
Fordhook Famous	Jan. 23	May 31	July 3	Aug. 6	9,634	5,427	15,061
White Spine	....do....	....do....	....do....	....do....	9,146	4,938	14,084
Long Green	Jan. 27	June 8	July 12	....do....	9,573	4,939	14,512
White Spine	Feb. 14	June 11	July 26	Aug. 14	8,109	4,878	12,987
Long Green	....do....	....do....	July 12	....do....	6,707	4,146	10,853

All of these varieties have proved valuable in this climate. The earlier plantings produce the largest yields, as the later plantings are damaged by the high summer temperatures.

POTATOES.

To secure a supply of seed potatoes of the variety best adapted to this region has in past years been a problem of considerable difficulty. Unless potatoes are planted during January, good yields ordinarily can not be expected. With this problem in mind, a test of different seed stocks of the Irish Cobbler variety was conducted during the spring of 1917. In this test a good strain of Irish Cobbler seed was compared with immature seed that had been grown as an autumn crop on the experiment farm the preceding year, and also potatoes of the spring crop of the preceding year that had been shipped to a cool climate for summer storage. The results of this test are recorded in Table XXVII.

TABLE XXVII.—*Tests of different seed stocks of Irish Cobbler potatoes on the Yuma Experiment Farm in 1917.*

Strain of seed.	Date—		Yield per acre (bushels).	
	Planted.	Harvested.	Total.	Marketable.
Eastern seed	Jan. 22	June 5	80.5	51.5
Do	....do....	June 9	98	61.9
Average			89.3	56.7
Local seed, 1916 crop	Jan. 22	May 26	36.6	14.3
Local seed, 1916 autumn crop	....do....	June 25	28.3	21.6

These yields are all smaller than those ordinarily obtained from this variety of potato. The average production for the Irish Cobbler for the years 1915, 1916, and 1917 at this station was 86. 2 bushels per acre.

It has always been found very difficult to keep potatoes for many weeks in this climate, and the result follows that no stocks of locally produced seed potatoes are carried from one season to the next spring for planting. The locally produced seed potatoes used in this test were shipped to San Diego, Cal., where they were stored, and they were returned to the experiment farm in the early winter. The production of potatoes late in the season as an autumn crop is not a reliable practice for maintaining a seed supply, as total failures of such a crop very frequently occur.

Approved:
WM. A. TAYLOR,
Chief of Bureau.

JULY 31, 1918.

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IN THE FIELD OF AGRICULTURE we have agencies and instrumentalities, fortunately, such as no other government in the world can show. The Department of Agriculture is undoubtedly the greatest practical and scientific agricultural organization in the world. Its total annual budget of $46,000,000 has been increased during the last four years more than 72 per cent. It has a staff of 18,000, including a large number of highly trained experts, and alongside of it stand the unique land-grant colleges, which are without example elsewhere, and the 69 State and Federal experiment stations. These colleges and experiment stations have a total endowment of plant and equipment of $172,000,000 and an income of more than $35,000,000, with 10,271 teachers, a resident student body of 125,000, and a vast additional number receiving instruction at their homes. County agents, joint officers of the Department of Agriculture and of the colleges, are everywhere cooperating with the farmers and assisting them. The number of extension workers under the Smith-Lever Act and under the recent emergency legislation has grown to 5,500 men and women working regularly in the various communities and taking to the farmer the latest scientific and practical information. Alongside these great public agencies stand the very effective voluntary organizations among the farmers themselves, which are more and more learning the best methods of cooperation and the best methods of putting to practical use the assistance derived from governmental sources. The banking legislation of the last two or three years has given the farmers access to the great lendable capital of the country, and it has become the duty both of the men in charge of the Federal-reserve banking system and of the farm-loan banking system to see to it that the farmers obtain the credit, both short and long term, to which they are entitled not only, but which it is imperatively necessary should be extended to them if the present tasks of the country are to be adequately performed. Both by direct purchase of nitrates and by the establishment of plants to produce nitrates, the Government is doing its utmost to assist in the problem of fertilization. The Department of Agriculture and other agencies are actively assisting the farmers to locate, safeguard, and secure at cost an adequate supply of sound seed.—*From President Wilson's Message to the Farmers' Conference at Urbana, Ill., January 31, 1918.*

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